NEWER ECHOCARDIOGRAPHIC PARAMETERS IN ASSESSING RV AND LV FUNCTION IN PATIENTS WITH CORPULMONALE

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CERTIFICATE

This is to certify that the dissertation titled "**NEWER ECHOCARDIOGRAPHIC PARAMETERS IN ASSESSING RV AND LV FUNCTION IN PATIENTS WITH CORPULMONALE"** is the bonafide original work of Dr**. N. VISWANATHAN**, in partial fulfillment of the requirements for D.M. Branch-II (CARDIOLOGY) examination of THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY to be held in August 2013.The period of post-graduate study and training was from August 2010 to July 2013.

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DECLARATION

I, **Dr.N.VISWANATHAN**, solemnly declare that this dissertation entitled, "**NEWER ECHOCARDIOGRAPHIC PARAMETERS IN ASSESSING RV AND LV FUNCTION IN PATIENTS WITH CORPULMONALE**" is a bonafide work done by me at the department of Cardiology, Madras Medical College and Government General Hospital during the period 2010 – 2013 under the guidance and supervision of the Professor and Head of the department of Cardiology of Madras Medical College and Government General Hospital, Professor V.E.Dhandapani M.D.D.M. This dissertation is submitted to The Tamil Nadu Dr.M.G.R Medical University, towards partial fulfillment of requirement for the award of **D.M. Degree (Branch-II) in Cardiology**.

Place: **SIGNATURE OF THE CANDIDATE**

Date

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CONTENTS

INTRODUCTION

In India still pulmonary tuberculosis is prevalent and stays as one of the leading cause of death. The cause of the death in most of the terminally ill pulmonary tuberculosis patient is corpulmonale and related cardiac problem. With the increase in incidence of retro viral infection and diabetes the prevalence of multi drug resistant pulmonary tuberculosis is high .This leads to increase in the chances for the corpulmonale.

In the rural areas poverty and malnutrition lead to increased incidence and prevalence of tuberculosis. In the urban areas exposure to the automobile gases and dust particles predisposes patients to pulmonary diseases and COPD in later life.

COPD in the later stages lead to right ventricular dilatation and corpulmonale. The development and implementation of the national programs for the detection and treatment of the tuberculosis is trying to treat the disease in the early stage itself to prevent such corpulmonale in future. In this study we are going to find easy solution to diagnose the lung disease related cardiac problem in the early stage itself without making mistakes.

In corpulmonale patients right ventricular systolic dysfunction is recognized to occur and it has been proved in many studies. But the corpulmonale patients are symptomatic not only because of the lung pathology and right heart failure, but also due to left ventricular dysfunction in the form of left ventricular systolic and left ventricular diastolic dysfunction .The dilated right ventricle pushes the interventricular septum towards left ventricle and interferes with left ventricular filling, which lead onto diastolic dysfunction of left ventricle. The additional metabolic factors like hypoxia, hypercapnea and acidosis lead on to direct myocardial depressant action and produce myocardial dysfunction in both left and right ventricle.

So picking up left ventricular systolic and left ventricular diastolic dysfunction in patients with corpulmonale using simple echocardiographic parameters helps us to better assessment and understanding of the patients. So treatment can be planned accordingly.

Corpulmonale is an end stage disease of the heart due to many pulmonary diseases like pulmonary tuberculosis, COPD, interstitial lung disease, occupational diseases and others. The treatment for corpulmonale needs extra medication and diet restrictions. We are going to study about the changes made in the heart using echocardiography.

In corpulmonale patients the echo window is bit difficult to view .so assessment of right ventricular systolic, left ventricular systolic and left ventricular diastolic dysfunction in patients with corpulmonale using simple parameters like mitral annular plane systolic excursion (MAPSE),mitral annular systolic velocity(MASV), tricuspid annular plane systolic excursion(TAPSE) ,tricuspid annular systolic velocity(TASV),and e propagation velocity makes echocardiography more complete and easy.

These parameters are studied individually in many studies and results correlate well with left and right ventricular dysfunctions. In the out patients department the usage of these simple parameters help the physicians to assess the patients quickly also. we are going to compare these parameters with one another and going to prove their validity.

So in this study we are going to study the prevalence of right ventricular systolic, left ventricular systolic and diastolic dysfunction as well as the utility of these simple and newer echocardiographic parameters in patients with corpulmonale.

AIMS & OBJECTIVES

1. To study the utility of newer echocardiographic parameters like mitral annular plane systolic excursion, mitral annular systolic velocity, tricuspid annular plane systolic excursion, tricuspid annular systolic velocity, and ‘e’ propagation velocity in identifying right ventricular systolic ,left ventricular systolic and diastolic dysfunction in patients with corpulmonale

2. To study the prevalence of right ventricular systolic, left ventricular systolic and left ventricular diastolic dysfunction in patients with corpulmonale

REVIEW OF LITERATURE

Cor – Heart (Latin) and Pulmonale – of the Lungs (New Latin)

Pulmonary Heart disease

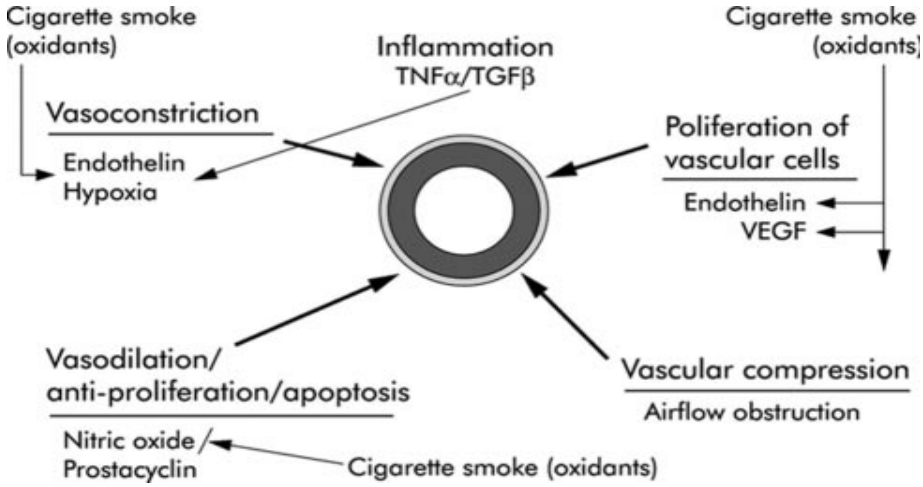
Chronic obstructive pulmonary disease (COPD), definition of GOLD is preventable and treatable disease with some significant extra lung pathology. Cor pulmonale was defined by the WHO in 1963 as "hypertrophy of the right ventricle resulting from diseases involving the physiology and or anatomy of the lungs, except when these pulmonary alterations are the result of diseases that primarily affect the left side of the heart, example as in congenital cardiac disease.

COPD is one of the major causes of morbidity worldwide. World Bank data tells that it is expected to move from 4th and 12th most frequent cause of mortality in 2000, to 3rd and 5th leading cause of mortality in 2020. COPD is associated with more effects on heart. Cardiovascular disease is responsible for 50% of all hospital admission and nearly one third of deaths. In more advanced disease heart problem is responsible for 20%–25% of all mortality in COPD. COPD affects lung blood vessels, right ventricle and left ventricle leading to development of pulmonary hypertension, cor pulmonale, right ventricular dysfunction, and left ventricular dysfunction also.

Echocardiography is a rapid, noninvasive and exact method to evaluate the right ventricular systolic function and filling pressure, tricuspid regurgitation, left ventricular function and functions of valve. Many studies have proved that echocardiographically arrived estimates of pulmonary arterial pressure co-relate closely with pressures measured by right heart catheter

The Right Ventricle in Pulmonary Hypertension.

The right ventricle is exposed to pressure overload by chronic corpulmonale from any cause. The initial adaptive response of right ventricular hypertrophy is followed later in life by right ventricular contractile dysfunction. Right ventricular dilatation follows to allow compensatory preload and maintain stroke volume in spite of reduced fractional shortening.



Pathogenesis of pulmonary hypertension in COPD

As contractility weakens, clinical evidence of right ventricular failure occurs, characterized by rise in filling pressures, diastolic dysfunction, and decreasing cardiac output, which is compounded by tricuspid regurgitation due to dilatation of right ventricular annulus and poor leaflet cooptation. The increased volume and pressure overload of the right ventricle also produce left ventricular diastolic dysfunction. Right ventricular function is very important determinant of survival in patients with pulmonary hypertension.

Clinical Presentation

Pulmonary hypertension in hypoxic lung diseases is common but usually mild to moderate in severity. Breathlessness is the most frequent symptom, but may not be helpful because breathlessness is so prevalent in this patient population.

A change in breathlessness or the development of extra symptoms such as angina, dizziness, syncope, and pedal edema may suggest further evaluation. physical examination findings common in idiopathic pulmonary hypertension such as a right ventricular heave, loud pulmonary component of the S2, tricuspid regurgitant murmur, and RV S4 may also be masked by the presence of parenchymal pulmonary disease.

Severe pulmonary hypertension may lead to ascites and peripheral edema. Few patients with severe COPD may develop pedal edema in the absence of RV failure, the cause of which is hypercapnia, suggesting that an elevated carbon dioxide partial pressure may be responsible for sodium retention. Hypoxemia itself may cause renal vasoconstriction, thus reducing urinary sodium excretion and lead to pedal edema.

In corpulmonale patients the right ventricular systolic and diastolic dysfunction recognized to occur. This concept is proved in many studies. Presence of pulmonary hypertension interferes with the right ventricular systolic and diastolic function. The dilatation of the right ventricle interferes with diastolic filling of left ventricle. This also leads to decreased left ventricular ejection fraction and finally systolic function of left ventricle is also affected.

In the 1996, Italian study on echocardiographic Doppler evaluation of left ventricular impairment in chronic corpulmonale concluded that left ventricular filling is compromised due to shift of interventricular septum towards left ventricle. This also concluded that severity of pulmonary hypertension also correlates with the severity of left ventricular diastolic dysfunction. It was published in 1996 June edition of CHEST journal.

Right ventricular volume overload causes flat interventricular septum and the curvature is lost. Also in corpulmonale patients greater negative intrathoracic pressure is needed for the lungs to get inflated. This leads to increase in left ventricular after load. This increase in left ventricular after load also impairs left ventricular systolic function. Hypoxia interferes with intracellular calcium transport.

So the left ventricular relaxation during diastole is greatly affected. In an Indian study published in Indian journal, the left ventricular function was assessed in three categories of patients. Category 1 (35 patients) patients had COPD only. Category ii (21 patients) is COPD with corpulmonale but without ventricular failure and right ventricular dysfunction and category iii (14patients) is COPD with corpulmonale with right ventricular dysfunction

The left ventricular ejection fraction was assessed in category iii (14patients) i.e. COPD with corpulmonale with right ventricular dysfunction. This was only on an average 45.6% in this category, but 68.5% and 70.8% in category ii and category I patients respectively. This clearly implies that right ventricular dysfunction leads to left ventricular dysfunction soon. Hypercapnea and acidosis of corpulmonale still depress the left ventricular function by its suppressant

action on myocardium. The left ventricular function further leads to deterioration of corpulmonale due to metabolic and mechanical factors. The left ventricular failure even if subclinical leads to delay in expected improvement in overt right ventricular failure in corpulmonale patients. Also biventricular failure in corpulmonale patients leads to kind of refractory heart failure.

Assessment of right ventricular systolic function using TAPSE (tricuspid annular plane systolic excursion) is validated in many studies. In one study published in European heart journal 2007 June, right ventricular systolic function was studied using TAPSE. This correlated well with the right ventricular systolic function. Also TAPSE decreased as the severity of the pulmonary hypertension increased.

In another TAIWAN study published in 2007 February, right ventricular systolic function was studied in scleroderma patients. In this study TAPSE and right ventricular systolic function were calculated separately and compared. It showed excellent correlation between TAPSE and right ventricular ejection fraction. TAPSE of less than 19.6mm was associated with right ventricular ejection fraction of less than 40% with very high specificity.

In Indian heart journal 2009 January, TAPSE in normal subjects and in patients with right ventricular dysfunction was studied. This was correlated with fractional shortening and annular plane systolic velocity. The value of less than 17mm TAPSE was identified in patients with right ventricular dysfunction.

American journal of respiratory critical care medicine November 2006 published prognostic value of TAPSE in patients with established pulmonary hypertension. The value of < 18mm was associated with significantly increased mortality. This study concluded with the result of TAPSE being the powerful indicator of right ventricular systolic function.

Another important marker of right ventricular systolic function is TASV (tricuspid annular systolic velocity).This is calculated by tissue Doppler method. Sample volume is placed in the lateral tricuspid annulus and systolic velocity is calculated. The normal value in person with intact right ventricular systolic function is >10 cm/sec.

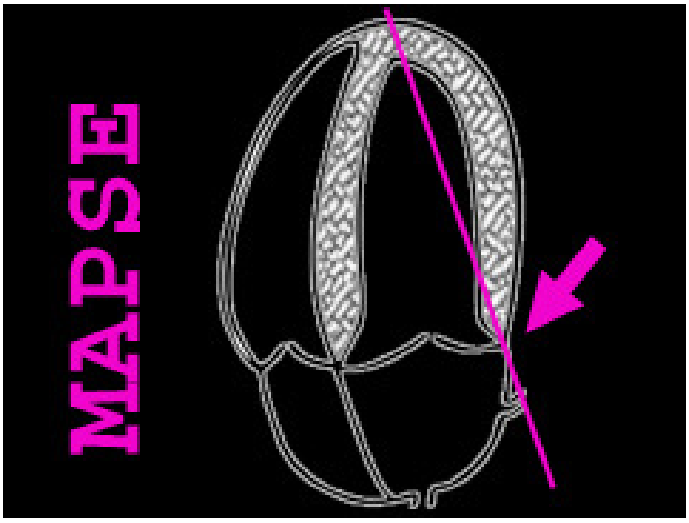
In one study conducted in Pittsburgh medical centre USA, TAPSE was compared with TASV. In this study TAPSE correlated well with TASV. But in this study TASV more than 10.5 cm/sec identified

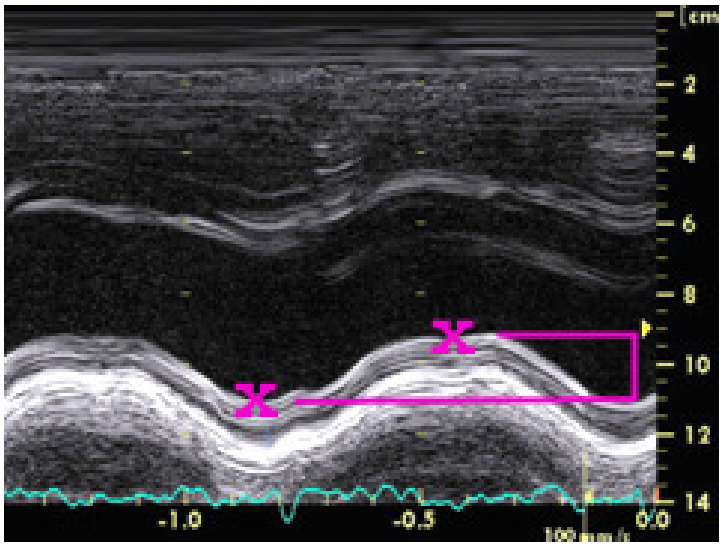
normal person. From this study we can infer that TASV is as good as TAPSE and can be measured simultaneously and easily.

In another Swiss study published in 2005 the tricuspid annulus systolic velocity of lateral annulus> 12cm/sec identified normal systolic function with right ventricular ejection fraction of >55%. TASV <9cm/sec in patients with right ventricular dysfunction was able to identify the problem correctly and right ventricular ejection fraction in this patients were between 30-55%.

MAPSE (mitral annular plane systolic excursion)

For assessment of left ventricular systolic function, MAPSE (mitral annular plane systolic excursion) is used. It is the measure of longitudinal systolic function of the left ventricle. It is calculated by the following steps.


MAPSE


cm
2
4
6
8
10
12
14
-1.0
-0.5
0.0

1. Two dimensional Apical four chamber is viewed.
2. M-mode line is placed on the lateral mitral annulus
3. Distance between the end diastole and peak systole is measured.

MAPSE (mitral annular plane systolic excursion) can be calculated in both medial and lateral mitral annulus and average can also be taken. The normal value for MAPSE (mitral annular plane systolic excursion) is more than 10 mm. This is very important tool and can be very sensitive than left ventricular ejection fraction in identifying the left ventricular function.

A study published in European heart journal 2011 September compared 62 heart failure patients with preserved ejection fraction patients with vo2 max 18.6±5 ml/min/kg with normal persons. MAPSE (mitral annular plane systolic excursion) in these patients at rest was 10.9±2.1. But in normal persons it was 12.1±2.2. With exercise the MAPSE in patient's was12±2.2. But in normal persons it rose to 16.2±2.7. So this study concluded that MAPSE (mitral annular plane systolic excursion) is a highly reliable and important tool in patients of heart failure with normal left ventricular ejection fraction.

In the journal of cardiovascular magnetic resonance the cut off value for MAPSE and TAPSE has been published in the year 2012. For

males of age 35-50 years MAPSE is 12.8 ±7.3mm. For females of same age it is 15.7±7.1mm.

For males of age 35-50 years TAPSE is 19.3 mm. For females of same age it is 20.4mm. In patients with decreased ejection fraction, MAPSE was less than 6 mm.

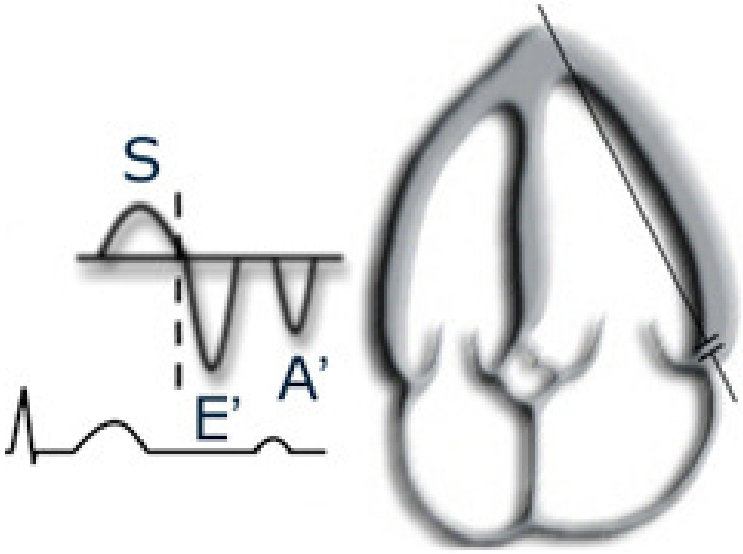
This study concluded that MAPSE has got accurate relationship with left ventricular ejection fraction.

In the American journal of echocardiography September 2012 a study of correlation of MAPSE with LVEF has been published. In this study MAPSE was calculated by untrained person and LVEF was calculated by experienced echocardiographer.

In patients with normal ejection fraction MAPSE >11mmfor females and >13mm for males were found .In patients with decreased ejection fraction MAPSE was <6mm. This had concluded that MAPSE has got accurate relationship between with left ventricular ejection fraction. many studies with MAPSE showed that the longitudinal left ventricular systolic function correlate well with other parameters for left ventricular systolic function

MASV (mitral annular systolic velocity)

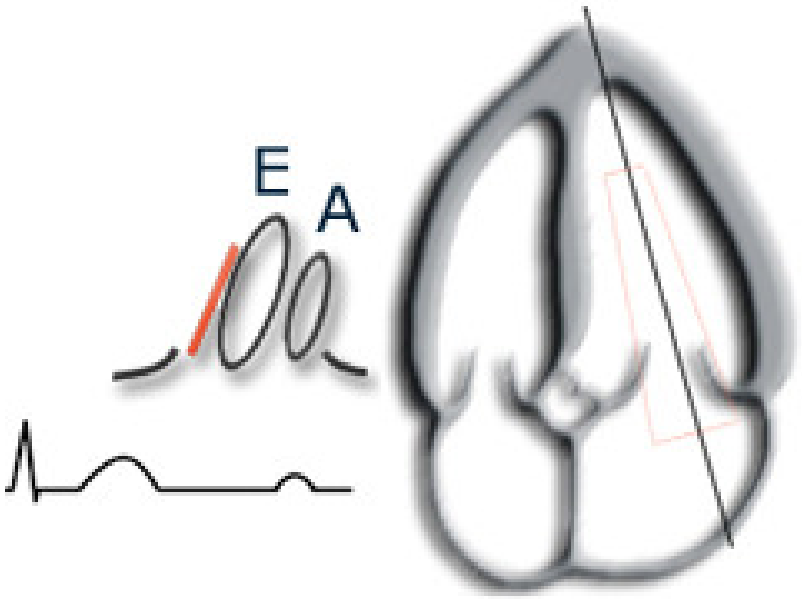
MASV (mitral annular systolic velocity) is measured by tissue Doppler method. The sample volume is placed in the lateral mitral annulus and the systolic velocity is calculated in c.m/sec.



In the journal of cardiovascular ultrasound 2010 march the MASV (mitral annular systolic velocity) is compared with left ventricular ejection fraction. Here the cutoff value was taken as 6.8 c.m/sec. For the patients with left ventricular systolic dysfunction the value is less than 6.8cm/sec. In this study the left ventricular ejection fraction was calculated by three dimensional echocardiography.

In another study published in 2012 cardiovascular ultrasound journal MASV (mitral annular systolic velocity) was calculated in hypertensive patients with diastolic dysfunction. This showed decreased MASV (mitral annular systolic velocity) which is a marker of longitudinal left ventricular systolic function. In this study control group population without hypertension showed normal MASV (mitral annular systolic velocity).

Mitral 'e' propagation velocity



To assess the left ventricular diastolic dysfunction the mitral e propagation velocity is one of the parameters. It is calculated by following steps.

1. To obtain two dimensional echo apical four chamber view and apply color Doppler at the mitral valve.

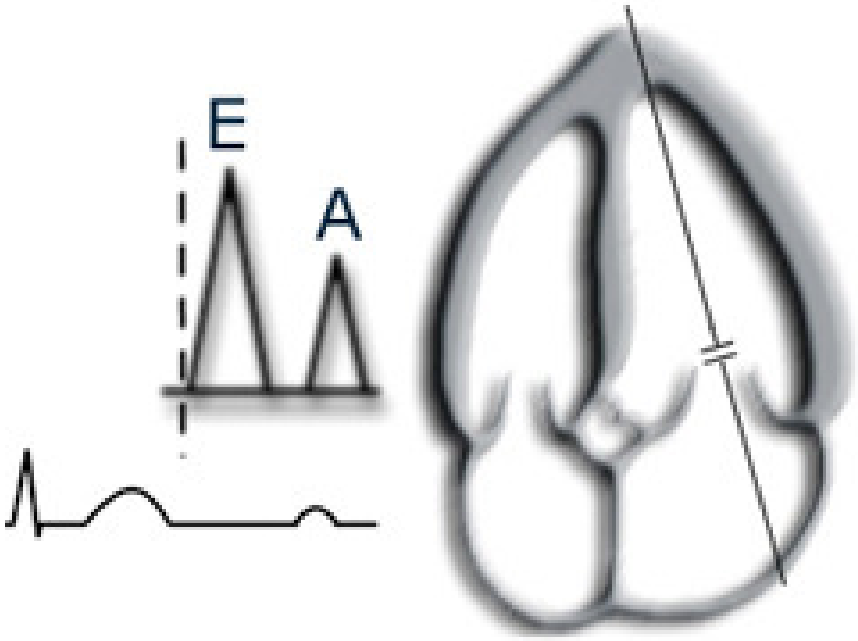
2. Then the M-mode line is placed on the line of color flow between mitral valve and left ventricular apex.

3. The early diastolic E flow is recorded and the Nyquist limit is adjusted as though no aliasing occur.

4. The velocity in the early phase of diastole i.e. the ‘e’ slope velocity is recorded.

The normal value for ‘e’ propagation velocity is >50cm/sec.

The values of ‘e’ propagation velocity more than 50cm/sec indicates that there is good diastolic flow from LA to LV and also indicate intact diastolic function of the ventricle. The value of ‘e’ propagation velocity less than 50 cm/sec indicates left ventricular diastolic dysfunction.



There is also correlation between ‘E’ peak velocity and Vp propagation velocity. The ratio of E/Vp more than 2.5 indicates raised pulmonary capillary wedge pressure more than 15 mmHg.

In a study conducted in Poland in 2006 by Krystian Wite et al, Propagation velocity was calculated in patients with known diastolic dysfunction. The patients with diastolic dysfunction are categorized into three groups. The third group comprised of Grade 3 diastolic dysfunction. These patients had more decreased propagation velocity and increased pro-BNP level.

In European respiratory journal 2008, LV diastolic dysfunction was studied in idiopathic pulmonary fibrosis patients. In this study the mitral inflow reversal was noted in all the patients and diastolic function was assessed by 'e' propagation velocity was 46±13 cm/sec which was higher in normal individuals of about 83±21 cm/sec.

In Chest journal 2003, Cystic fibrosis patients are studied for RV and LV function. In the 40 patients studied all of them showed RV systolic dysfunction and LV diastolic dysfunction. But LV systolic function was not significantly decreased in these groups.

In 2006 Serbia Cardiovascular clinics of the Clinical centre NIS, 50 patients with chronic cor pulmonale were studied for LV diastolic function and the results were compared with 56 patients of COPD without heart failure.

In conclusion, that the LV diastolic dysfunction was due to the progression of the right heart failure due to cor pulmonale and it indicates advanced disease.

In an Indian study conducted in Rajasthan in 2009, COPD patients were completely studied for Right and Left ventricular functions using Echocardiography. Among them, 2/3 of the patients had pulmonary hypertension and tricuspid regurgitation. The LV systolic dysfunction was seen in <10% of the cases and left ventricular diastolic dysfunction was found in almost half number of the cases. This study

also concluded the fact that echocardiography is extremely useful in early detection of cardiac complication in COPD patients.

In Turkish study 30 patients of Sarcoidosis were studied for cardiac involvement by echocardiography method. Among them, sixteen patients showed LV diastolic dysfunction even if there is no clinical proof of it. It was in the form of reversal of E/A ratio. This figure of more than 50% of LV diastolic dysfunction was very significant when compared to previous studies.

In our study, Cor pulmonale patients are studied by newer echocardiographic methods, unlike the previous studies. This enables us to detect the abnormality easily and accurately.

Traditionally, Cor pulmonale patients are defined by increase in bulk of the right ventricle due to lung pathology. The lung pathology in our group varied from chronic bronchitis, emphysema, old pulmonary tuberculosis, previous lung surgery and bronchiectesis.

Interstitial Lung Disease

Diffuse parenchymal lung diseases (DPLDs) have also been linked with cor pulmonale. DPLDs are a heterogeneous group of diseases with similar clinical, x-ray, and physiological manifestations. This disease results in alterations in the alveolar walls, perialveolar

tissue, and other supporting structures. Occupational and environmental exposures can lead to DPLD, although frequently the cause is Not clear. The prevalence of pulmonary hypertension in patients with DPLDs varies widely.

As in COPD, investigating method and criteria contribute to the variability between studies, with prevalence tending to be higher where echocardiography was used. Studies of persons undergoing evaluation for lung transplantation have clearly demonstrated a higher prevalence. Destruction and obliteration of the blood vessels secondary to loss of lung parenchyma and fibrosis plays a role. Studies of IPF have reported loss of blood vessels in areas of honeycomb lung and decrease in the mean capillary surface area.

Vessel compression may lead to in situ thrombosis, fibrous organization of blood vessels, and luminal obliteration. Abnormal connections between the pulmonary and systemic circulation have also been identified in patients with IPF.

Cor pulmonale is right ventricular enlargement due to high resistance or pulmonary hypertension. Chronic increase in pulmonary arterial pressure leads to right ventricular hypertrophy.

Pulmonary tuberculosis with corpulmonale

In Indian subcontinent still pulmonary tuberculosis is prevalent and stays as one of the leading cause of corpulmonale. With the increase in incidence of HIV infection and diabetes the prevalence of drug resistant pulmonary tuberculosis is high .This leads to increase in the chances for the corpulmonale .Immunodeficient states makes patient susceptible to chronic infection and so the incidence of infection to other people also increases.

In the rural areas poverty and malnutrition lead to increased incidence of the tuberculosis. In the urban areas exposure to the automobile gases and dust particles predisposes patients to pulmonary diseases. Silicosis which is a occupational disease leads to pulmonary tuberculosis. In tuberculosis the development of the corpulmonale is due to decrease of lung elasticity, parenchymal pathology, alteration in the diffusion capacity, obstruction of the bronchial tree due to brochospasm and destruction of the lung tissue.

The development of right ventricular enlargement takes many years to develop in corpulmonale patients. Smoking which is a risk factor for the development of the COPD is also a risk factor for the development of the coronary artery disease. So both of them co exist in

smokers. Presence of coronary artery disease in the COPD patients lead on to left ventricular systolic and diastolic dysfunction.

DYSPNEA IN COPD

The grade of dyspnea in COPD increases in patients with corpulmonale if coronary artery disease co exists. The development of the corpulmonale lead to the state of irreversible disease process and patients worsen day by day if the precipitating lung pathology is not relieved. Ascites in corpulmonale lead to elevation of the diaphragm and worsening of the dyspnea. Pleural effusion caused by the right heart failure still increase the grade of dyspnea.

Most of the previous studies are done in particular subset of patients with similar lung pathology and with only old echocardiographic parameters. Some parameters like RV tei index, RV ejection fraction and LV pulmonary flow reversal are not only time consuming and also difficult to view and interpret in already sick cor pulmonale patients.

So there is need for easier and simpler parameters like MAPSE, MASV, TASV, TAPSE and ‘e’ propagation velocity are very much in our setup. So we are going to study these in detail in this study.

MATERIALS AND METHODS

All patients of corpulmonale referred for the study of the heart by echocardiography are taken for the study and included. The patients were selected irrespective of the lung pathology that caused corpulmonale. Both male and female patients are selected for the study.

There was no age limit in our study population. Patients with acute corpulmonale were not included because of the acute symptoms.

Relevant history, clinical examination, X ray chest, E.C.G was taken for all the patients. Pulse oximetry, pulse rate, systolic and diastolic blood pressure and respiratory rate were taken.

All the patients underwent detailed echocardiographic study. Echocardiogram was done using Philips HD7XE Echocardiographic machine. The following echocardiographic parameters were done. Mitral annular plane systolic excursion (MAPSE), Mitral annular systolic velocity(MASV), Tricuspid annular plane systolic excursion(TAPSE), Tricuspid annular systolic velocity(TASV),and 'e' propagation velocity and E/A ratio were taken. TAPSE <17mm, MAPSE < 10mm, TASV < 10cm/s, MASV <7 cm/s and 'e' propagation velocity <50cm/s were taken as cut-offs for abnormal values as per

American Society of Echocardiography recommendations. Pulmonary hypertension was graded as mild, moderate and severe based on the tricuspid regurgitation pressure gradient on the echocardiography.

INCLUSION CRITERIA:

All patients of Corpulmonale evaluated in Department of Cardiology, Rajiv Gandhi Government General, Madras Medical College, Chennai

EXCLUSION CRITERIA

1. Patients with past history of CABG

2. Patients with PTCA.

3. Patients with valvular heart disease.

4. Patients with hepatic dysfunction.

5. Patients with a major non-cardiovascular disease.

6. Unwilling to give consent.

7. Patients with coronary artery disease

8. Patients with systemic hypertension

9. Patients with LV dysfunction of any cause

RESULTS AND DATA ANALYSIS

40 patients of established cor pulmonale were selected for the study. Among them 23 were males and 17 were females. All are having right ventricular enlargement due to lung pathology. Among them 30 patients have COPD, 8 patients have old pulmonary tuberculosis and 2 patients have interstitial lung disease. The COPD comprises of 75 % of study population; 20% of cases are old pulmonary tuberculosis and 5% of cases are interstitial lung disease patients.

Age of the patients ranged from 29 years to 70 years with the mean value of age is 49.5 years. Among female patients age range from 29 years to 68 years with the mean age of 48.5 years. For the male patients it ranged from 29 years to 70 years with mean age of 49.5 years.

Table 1: Age and Sex distribution of Study Population

Age Group	Male		Female		Total	
	No of Patient	%	No of Patients	%	No of Patients	%
< 30	1	4.3	1	5.9	2	5
31- 40	6	26.1	4	23.5	10	25
41 -50	6	26.1	4	23.5	10	25
51 – 60	6	26.1	6	35.3	12	30
61 – 70	4	17.4	2	11.8	6	15
Total	23	100	17	100	40	100
Mean ± S D	**49.0 ± 11.38**		**49.52 ± 10.9**		**49.22 ± 11.04**	

Among the male patients corpulmonale is more common in the age group between 30-60 years of age .corpulmonale is less common before 30 years of age in both males and females. In female gender high prevalence was noted between 50-60 years of age. In the age group of 60-70 years corpulmonale is slightly higher in the females when compared to males.

Among these 40 patients 18 patients had mild pulmonary hypertension, 8 patients had moderate pulmonary hypertension and14 patients had severe pulmonary hypertension. These comprises of 45% of patients with mild pulmonary hypertension, 20% of patients with moderate pulmonary hypertension and 35% of patients with severe pulmonary hypertension.

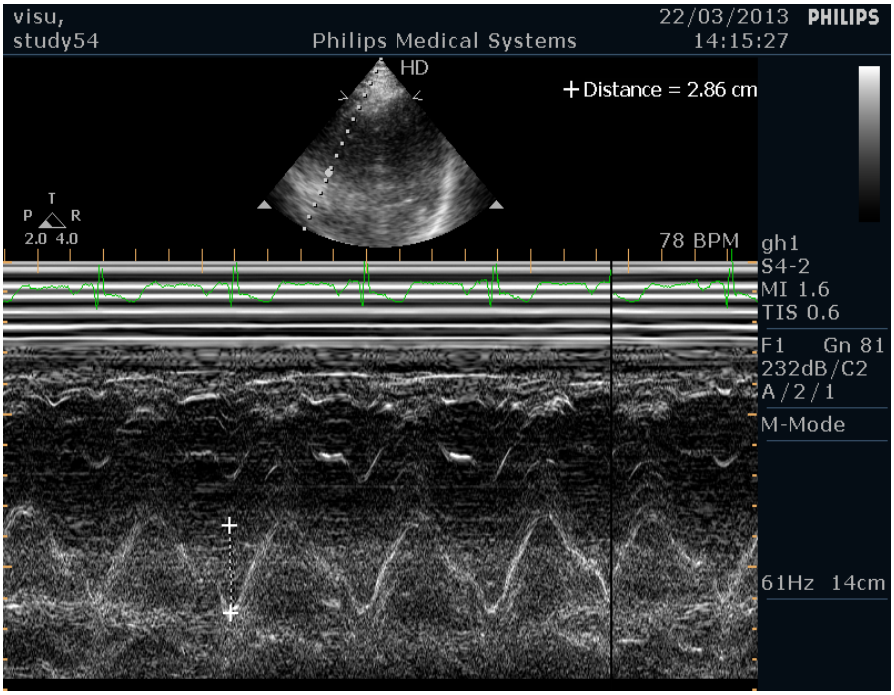
Table 2: Severity of Pulmonary Hypertension

Pulmonary Hypertension	**Male**		**Female**		**Total**	
	No of Patient	**%**	**No of Patients**	**%**	**No of Patients**	**%**
Mild	9	39.13	9	52.94	18	45
Moderate	5	21.74	3	17.64	8	20
Severe	9	39.13	5	29.42	14	35
Total	23	100	17	100	40	100

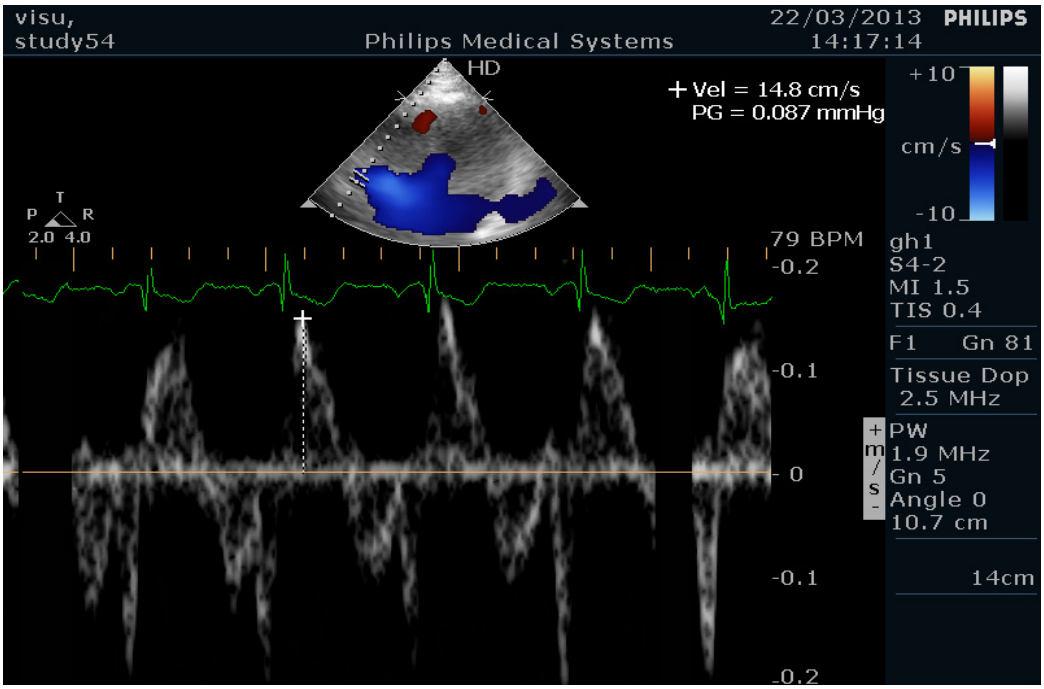
The prevalence of mild pulmonary hypertension is more in females. The severe pulmonary hypertension prevalence is more in the males. This severe pulmonary hypertension being more common in males is probably due to increased smoking in the males. In the study population also males are more commonly affected than the females because of the same reason.

TAPSE of < 17mm was taken as having right ventricular systolic dysfunction in our study. 38 out of 40 patients had TAPSE of <17 MM. so prevalence of TAPSE calculated right ventricular systolic dysfunction is 95 % in our study. 5 % of patients were not having right ventricular systolic dysfunction when TAPSE was taken as the echocardiographic parameter. TASV of < 10 cm/sec was taken as having right ventricular systolic dysfunction in our study. 36 out of 40 patients had TASV of <10 cm/sec. so prevalence of TASV calculated right ventricular systolic dysfunction is 90 % in our study. 10 % of patients were not having right ventricular systolic dysfunction when TASV was taken as the parameter.

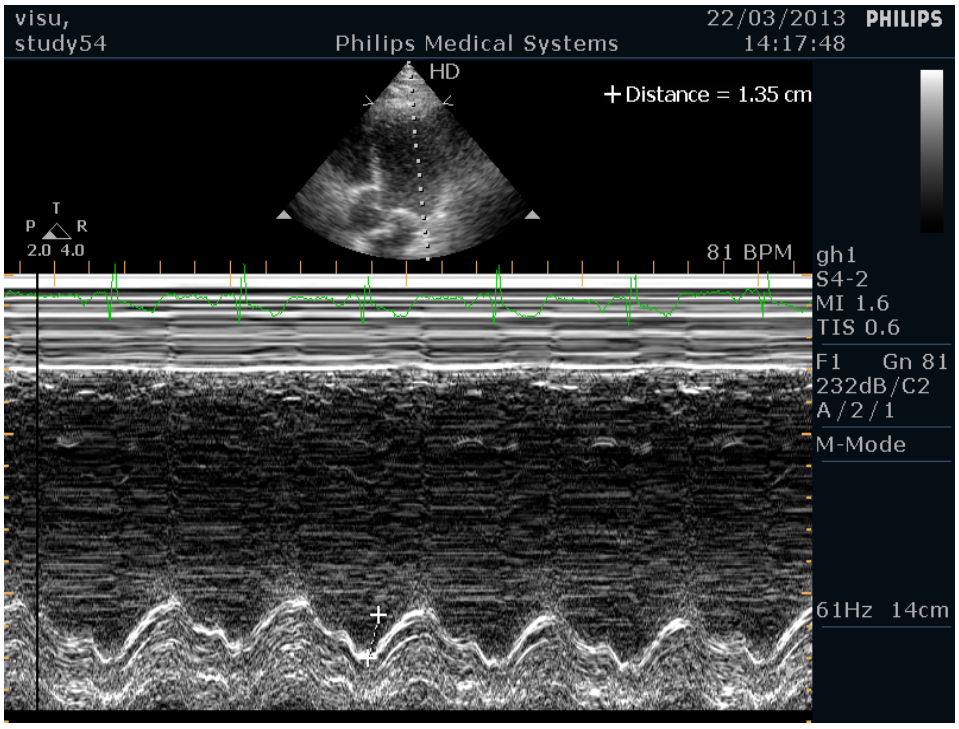
TAPSE (tricuspid annular plane systolic exertion)



TASV (tricuspid annular systolic velocity)

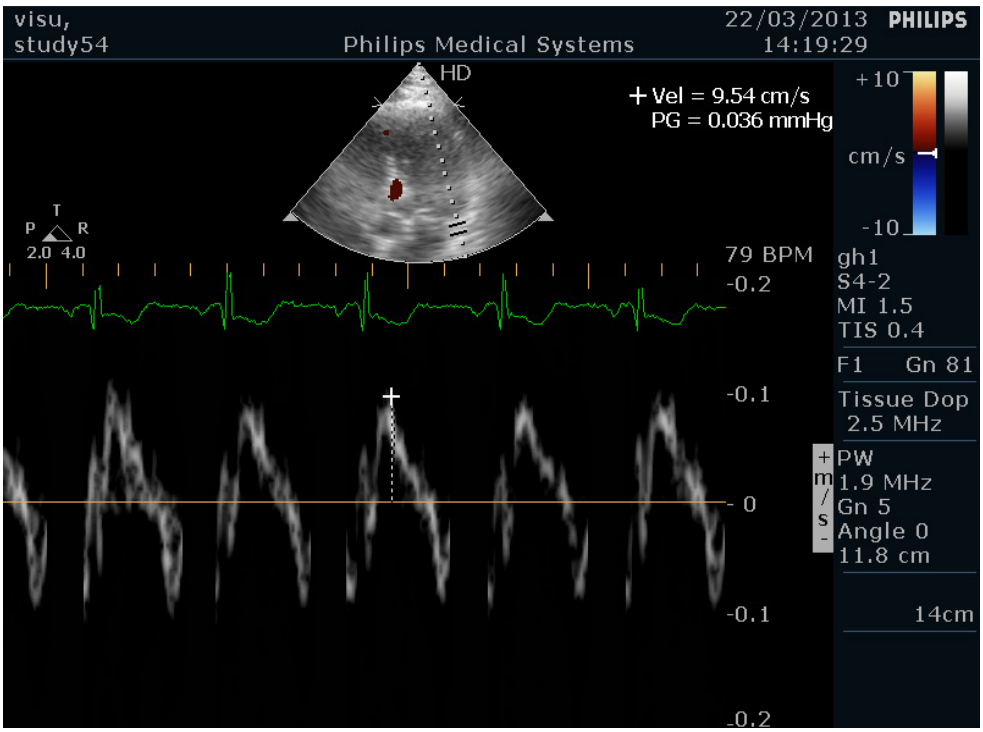


MAPSE (mitral annular plane systolic exertion)



MAPSE is considered to represent left ventricular systolic dysfunction when it is <10mm in our study. MAPSE was < 10mm in 8 out of 40 patients. So prevalence of MAPSE calculated left ventricular systolic dysfunction is 20 % in our study. 80 % of patients were not having left ventricular systolic dysfunction when MAPSE was taken as the echocardiographic parameter.

MASV (mitral annular systolic velocity)



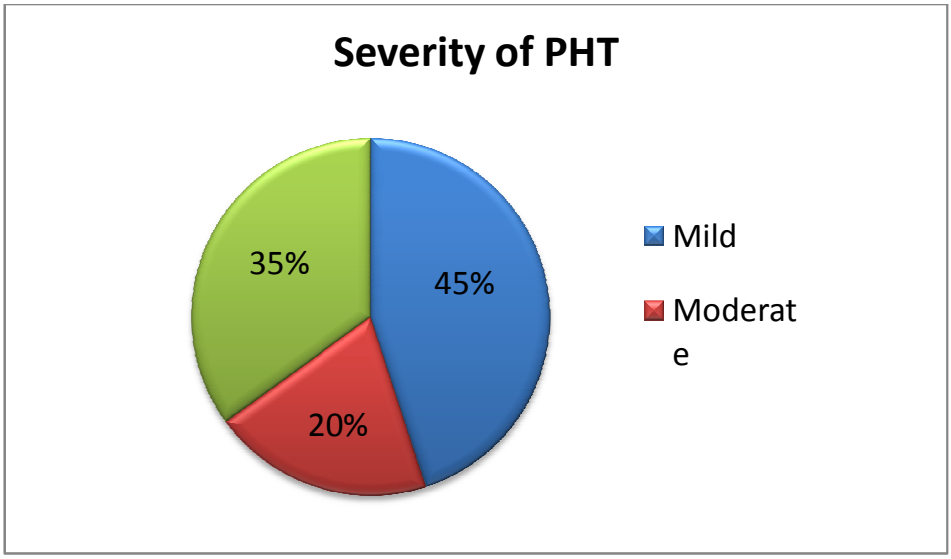
MASV of < 7 cm/sec was taken as having left ventricular systolic dysfunction in our study. 5 out of 40 patients had MASV of <7cm/sec. so prevalence of MASV calculated left ventricular systolic dysfunction is 12.5 % in our study. 87.5 % of patients were not having left ventricular systolic dysfunction when MASV was taken as the echo parameter.

‘e’ propagation velocity

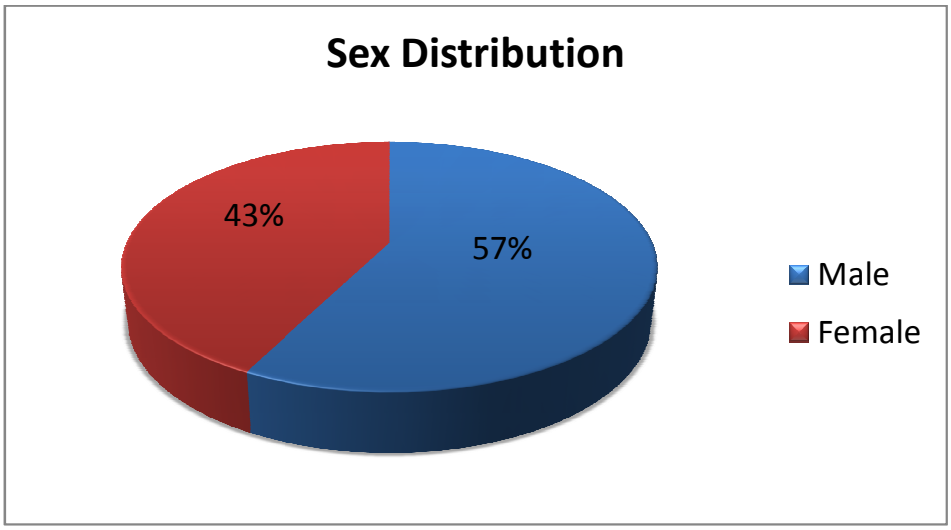
‘e’ propagation velocity of <50 cm/sec is taken as having left ventricular diastolic dysfunction in our study. 18 out of 40 patients had ‘e’ propagation velocity of <50 cm/sec. so prevalence of e propagation velocity calculated left ventricular diastolic dysfunction is 45 % in our study. 55 % of patients were not having left ventricular diastolic dysfunction when e propagation velocity was taken as the echo parameter.

When E/A ratio is taken as echo parameter, to calculate left ventricular diastolic dysfunction in our study, 22 out of 40 patients had left ventricular diastolic dysfunction. So prevalence of E/A ratio calculated left ventricular diastolic dysfunction is 55 % in our study. 45 % of patients were not having left ventricular diastolic dysfunction when E/A ratio were taken as the echo parameter.

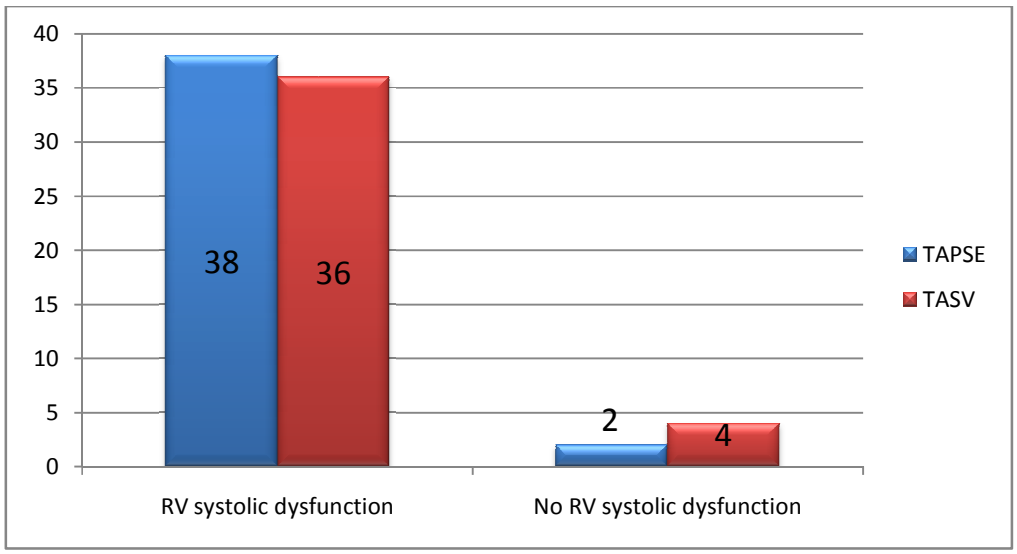
An average of about half of the study population had left ventricular diastolic dysfunction.



Mild pulmonary hypertension is more prevalent in the study patients



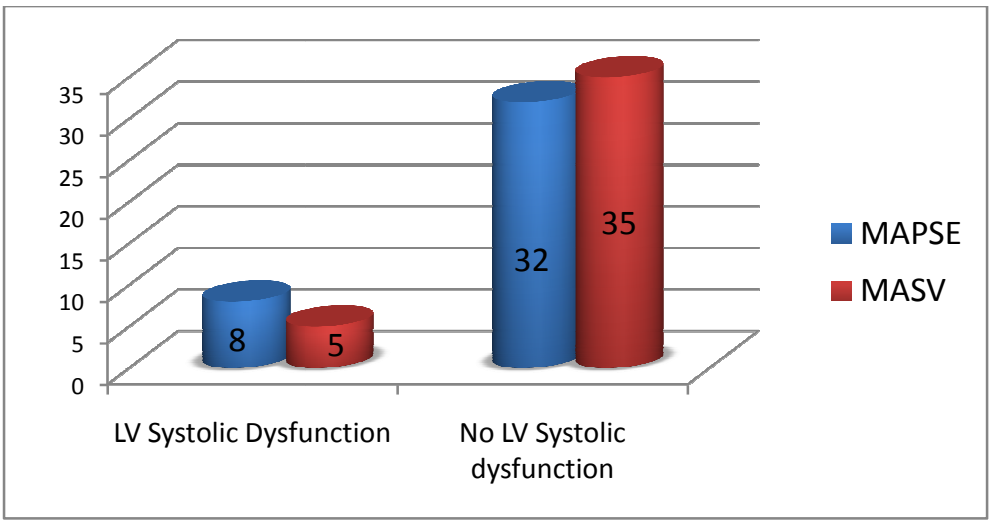
Male are more affected than the females.



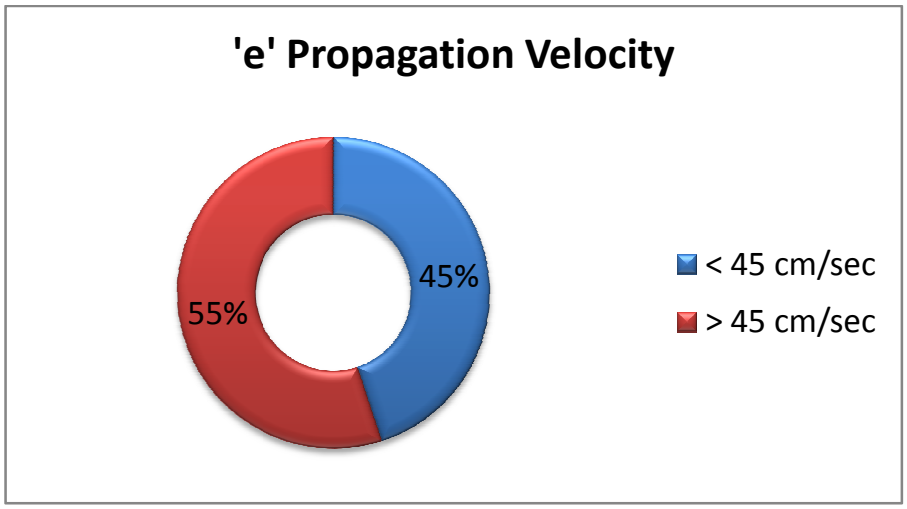
Prevalence of RV systolic dysfunction using TAPSE and TASV

TAPSE and TASV are more reliable parameters. Both of them correlate well with the right ventricular systolic dysfunction. Their sensitivity and specificity in identifying the problem was very high. They can detect even subtle problem which other parameters cannot do reliably. These simple parameters are proved useful in the acute set up also like right ventricular infarction in various studies.

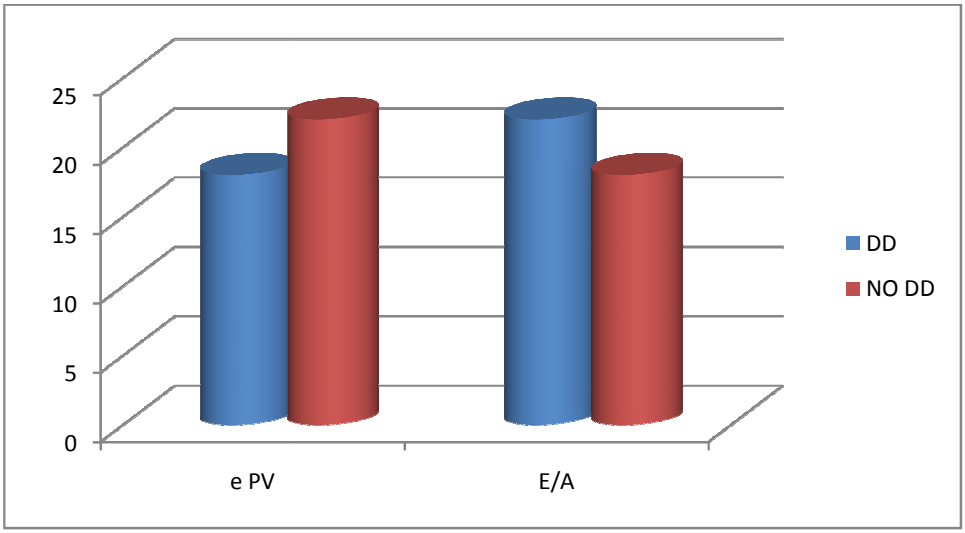
Prevalence of LV systolic dysfunction



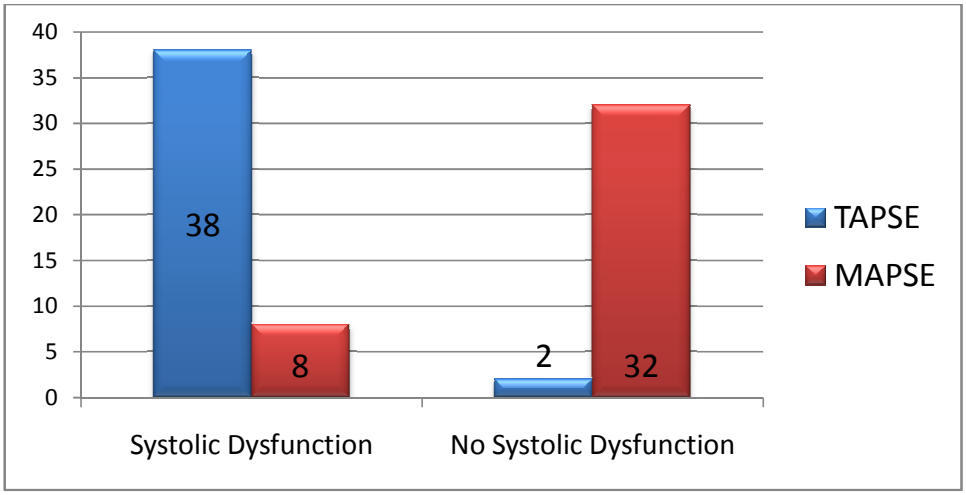
Assessment of LV systolic dysfunction in corpulmonale is very important for the evaluation of the dyspnea. sudden deterioration in the dyspnea is due to the progressive worsening of the systolic dysfunction. In our study patients with severe pulmonary hypertension have more prevalence of the LV systolic dysfunction.



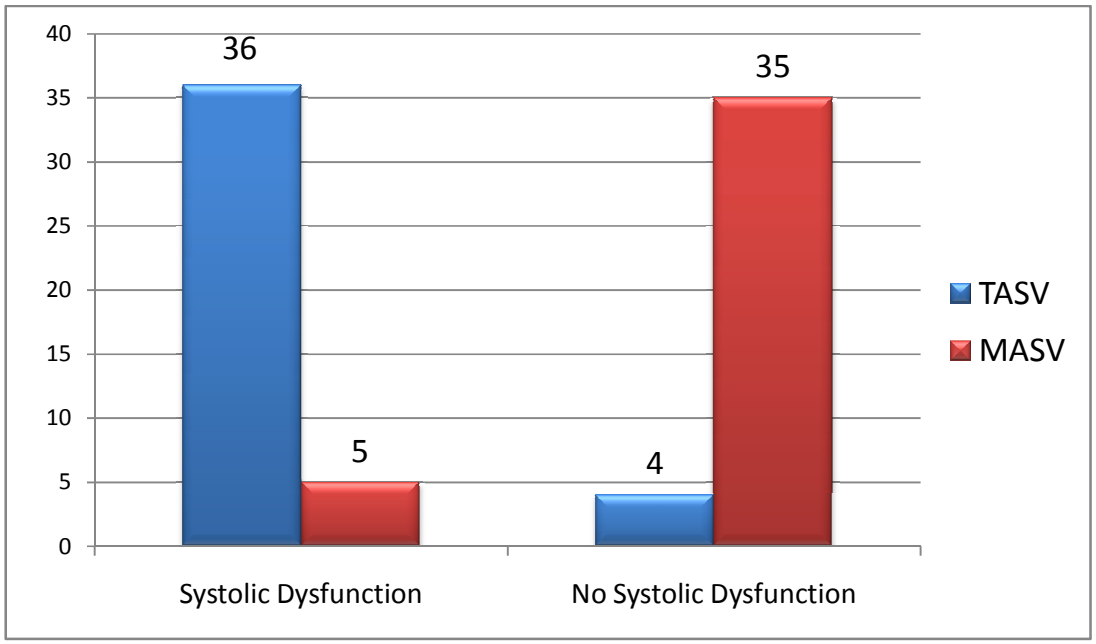
Comparison of ‘e’ PV and E/A ration in detecting LV DD. When compared to e propagation velocity, E/A ratio calculated left ventricular diastolic dysfunction is more.



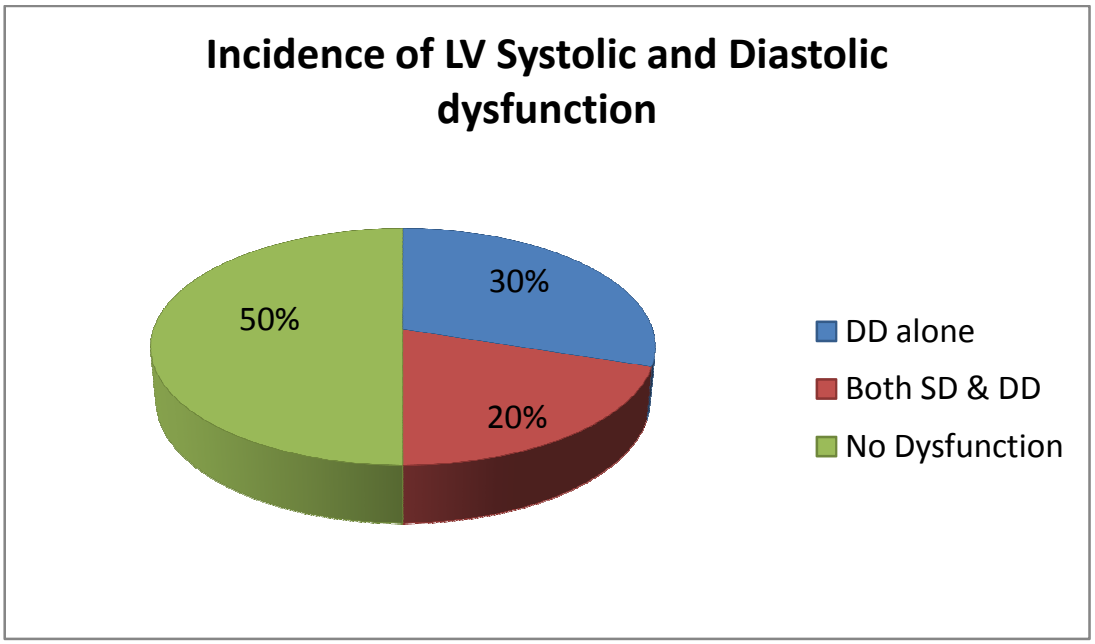
Comparing RV and LV systolic dysfunction in cor pulmonale



TAPSE assess longitudinal right ventricular systolic dysfunction and its calculation detects many patients with early systolic dysfunction .But left ventricular systolic dysfunction which occur very late in the course of the disease is not that common when compared to right ventricular systolic dysfunction. These two parameters are derived from m-mode echocardiography.



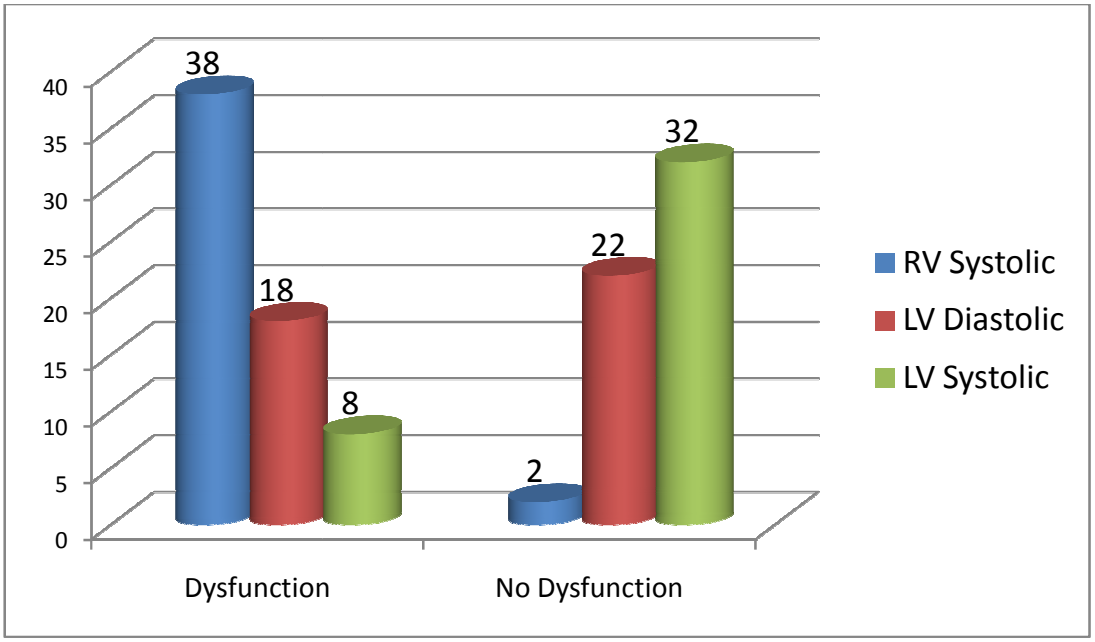
Tissue Doppler derived parameters like TASV and MASV also reflects the true state of the systolic functions of the right and left ventricle respectively. These results almost similar to results derived by other parameters.



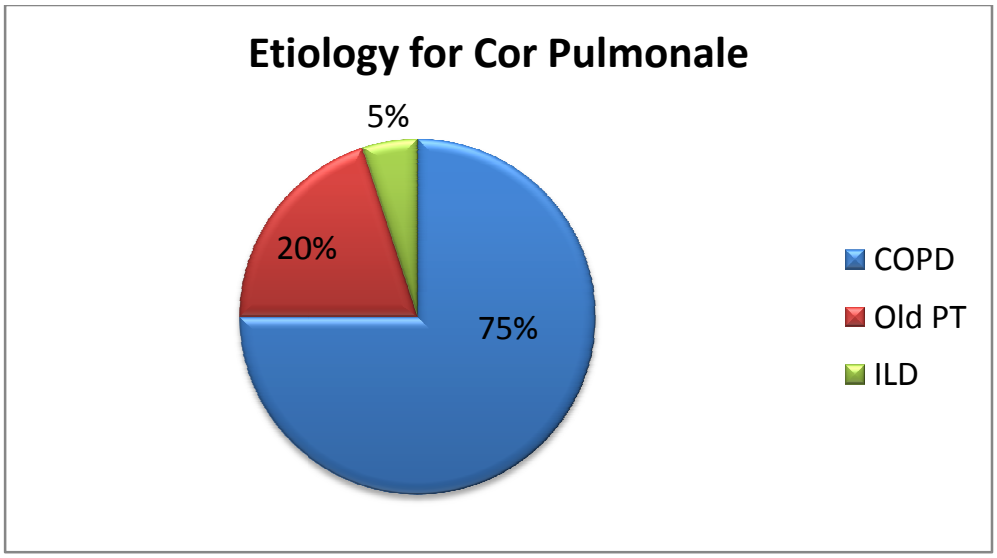
In patients with chronic corpulmonale both systolic and diastolic dysfunction of the left ventricle co exist .In our study 20% of the patients had both systolic and diastolic dysfunction of the left ventricle. They are more symptomatic than the patients with only diastolic dysfunction.

The patients without even left ventricular diastolic dysfunction make up almost half of the study population. They are better in the grade of dyspnea and symptoms.

Comparison of LV and RV dysfunction



In chronic cor pulmonale when compared to Right ventricular systolic dysfunction, Left ventricular dysfunction is rare. But some form of left ventricular diastolic dysfunction co exist in almost half of the cor pulmonale cases. Left ventricular diastolic dysfunction is common malfunction than the systolic dysfunction.



In our study, most common cause for cor pulmonale is COPD followed by old pulmonary tuberculosis. Interstitial lung diseases constitute about 5% of the cor pulmonale population.

DISCUSSION

This study was undertaken to establish the role of simple and useful parameters like TAPSE, TASV, MAPSE, MASV and e propagation velocity in patients with corpulmonale. Also in this study we aimed to study the prevalence of left ventricular systolic and diastolic dysfunction in corpulmonale cases.

TAPSE is a simple method when compared to RVEF and RV TEI index for studying right ventricular systolic dysfunction .It reliably detects right ventricular systolic dysfunction and the value decreased as the severity of systolic dysfunction worsen. Right ventricular systolic dysfunction was very much in patients with severe pulmonary hypertension when compared to mild pulmonary hypertension.

TASV is another newer parameter which utilizes tissue Doppler to assess the right ventricular systolic dysfunction. The value of <10cm/sec was taken as the cut off value .It correlated well with the TAPSE in identifying the right ventricular systolic dysfunction. It is well known that diseases like chronic bronchitis, pulmonary tuberculosis, emphysema, bronchial asthma, interstitial lung diseases and occupational diseases cause corpulmonale. But in our study COPD,

pulmonary tuberculosis and interstitial lung diseases were the diseases that caused the corpulmonale.

In tuberculosis cause for the development of the corpulmonale include decrease in the lung elasticity, parenchymal disease, and decrease in the diffusion capacity of the lung, obstruction of the bronchioles due to brochospasm and destruction of the lung tissue.

Development of the corpulmonale leads to terminal stage of the disease process and patient may go for congestive cardiac failure. Biventricular failure in pulmonary tuberculosis patients can be easily detected by echocardiography method using simple parameters like MAPSE,TAPSE,MASV and TASV.

MAPSE and MASV which is used to study the left ventricular function in our study are well accepted echo parameters. In future these parameters may replace the conventional methods. They can be compared with many other parameters for the similar purposes.

The concept that the left ventricular dysfunction which was believed not to occur with corpulmonale patients is now disproved. In our study almost half of the patients had left ventricular diastolic dysfunction and 10-20 % of cases had left ventricular systolic dysfunction. So patients with corpulmonale definitely need

echocardiographic evaluation for the complete understanding about the symptoms.

In corpulmonale cases sudden worsening of symptoms may be due to the development of left ventricular systolic dysfunction. So physician must be watchful about this problem.

It is also clear from the study that the above said echo parameters are non inferior and can be used in routine echocardiographic evaluation of cardiac patients. When there is doubt regarding the right and left ventricular function, various parameters can be compared and doubts can be clarified.

LIMITATIONS OF THE STUDY

1. The study does not include the acute corpulmonale patients

2. The COPD patients without obvious right ventricular and right atrial enlargement are not included in the study. So prevalence of the right ventricular and left ventricular dysfunction in those patients needs further evaluation

3. Right ventricular diastolic dysfunction which may be a earlier change in COPD was not included in the study.

CONCLUSION

1. Left ventricular diastolic dysfunction occurred in about 50% of the corpulmonale patients.

2. Left ventricular systolic dysfunction was observed in 10-20% percent in the study which is higher than the published literature.

3. MAPSE and MASV are simple and useful parameter to assess the left ventricular systolic dysfunction.

4. TAPSE and TASV are simple and useful index in corpulmonale patients to assess right ventricular systolic dysfunction.

5. It is found that atleast some amount of right ventricular systolic dysfunction was detected when the newer echocardiographic parameters were used in most of the corpulmonale patients.

MASTER CHART

S. NO	Patient No.	Sex	Age	PHT Severity	TRPG	TAPSE	TASV	MAPSE	MASV	e PV	E/A	DD	Diagnosis
1	Balamurugan	M	36	Mild	30	15	8	11	10	52	0.8	1	PT
2	Neela	F	40	Mild	32	15	9	11	8	70	0.7	1	PT
3	Kumaraguru	M	61	Severe	64	16	8	11	7	43	0.8	1	COPD
4	Muralidharan	M	56	Severe	87	12	9	8	7	39	1.1	2	COPD
5	Savithri	F	45	Moderate	44	14	8	9	5.2	40	1.2	2	PT
6	Ismail	M	48	Moderate	52	14	9	12	9.5	38	0.9	1	COPD
7	Hemavathy	F	59	Severe	67	13	5.5	13.5	10	34	0.9	1	COPD
8	Kumaran	M	43	Mild	33	16	8	13	10	68	1.1	0	COPD
9	Arumugam	M	64	Severe	69	13	6.1	6.8	5.5	39	1.1	2	COPD
10	Chithra	F	49	Mild	33	14	8	11	10	52	1.2	0	PT
11	Ramakrishnan	M	51	Mild	35	16	9	11	8	51	1.1	0	COPD
12	Selvi	F	58	Severe	72	13	9	11	8	40	0.8	1	COPD
13	Gowrishankar	M	44	Moderate	40	15	8	11	8	45	0.9	1	COPD
14	Anandhan	M	46	Severe	77	12	8	10	7	33	1.1	2	COPD
15	Shanmugam	M	39	Mild	31	16	9	11	10	84	1.2	0	COPD
16	Annakili	F	40	Severe	65	14	7	8	8	43	0.9	1	COPD
17	Dhandapani	M	33	Mild	34	16	9	12	8	56	1.2	0	PT
18	Bhuvana	F	35	Mild	35	20	15	11	9	96	1.3	0	COPD
19	Vedharajan	M	59	Mild	32	16	13	10	8	64	1.1	0	COPD

20	Kanagavalli	F	60	Moderate	53	16	7	10	7.5	46	1.1	0	COPD
21	Palaniappan	M	44	Mild	32	15	8	11	10	52	1.1	0	COPD
22	Catherine	F	49	Mild	33	16	9	11	8	70	1.1	0	COPD
23	Govindaraj	M	38	Severe	64	16	8	10	7	43	0.8	1	PT
24	Ponniammal	F	54	Severe	80	14	9	8	7	39	1.1	2	COPD
25	Kandasamy	M	70	Moderate	44	13	8	10	6	40	1.2	2	COPD
26	Murugaselvan	M	56	Moderate	52	16	9	12	9	38	0.9	1	COPD
27	Manoharan	M	69	Severe	63	15	5.5	13	10	34	0.9	1	PT
28	Pushpammal	F	64	Mild	31	16	8	13	10	68	1.1	0	COPD
29	Murugan	M	59	Severe	64	15	6.1	6	5.1	39	1.1	2	COPD
30	Malathy	F	44	Mild	33	16	8	11	10	52	1.1	0	COPD
31	Kannagi	F	38	Mild	35	15	9	12	8	51	1.1	0	COPD
32	Sasikumar	M	39	Severe	70	12	9	9	8	40	0.8	1	PT
33	Fathima	F	56	Moderate	48	15	8	12	8	45	1.2	0	COPD
34	Abdul Khadar	M	53	Severe	74	12	7	10	6.5	33	1.1	2	COPD
35	Valli	F	54	Mild	30	16	9	11	10	84	1.2	0	COPD
36	Krishna Veni	F	29	Severe	64	13	6	9	8	43	0.9	1	PT
37	Radha	F	68	Mild	34	16	9	10	8	56	1.2	0	COPD
38	Dhayalan	M	29	Mild	33	28	15	11	9	96	1.3	0	COPD
39	Joseph	M	40	Mild	32	15	13	10	8	64	1.1	0	COPD
40	Muniappan	M	50	Moderate	57	16	7	10	7.5	46	0.9	1	COPD

CONTENTS

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ABBREVIATIONS AND ACRONYMS

RV	-	Right Ventricle
LV	-	Left Ventricle
MAPSE	-	Mitral Annular Plane Systolic Excursion
TAPSE	-	Tricuspid Annular Plane Systolic Excursion
MASV	-	Mitral Annular Systolic Velocity
TASV	-	Tricuspid Annular Systolic Velocity
LVEDD	-	Left Ventricle End Diastolic Dimension
LV ESD	-	Left Ventricle End Systolic Dimension
EF	-	Ejection Fraction
RVEDD	-	Right Ventricle End Diastolic Dimension
RVESD	-	Right Ventricle End Systolic Dimension
RVFWT	-	Right Ventricle Free Wall Thickness

PROFORMA

Name:

Age:

Sex:

Address:

CD No. :

SYMPTOMS:

Chest pain:

SOB Class:

Palpitations

Right heart failure symptoms-

Risk Factors

h/o pul.TB

Diabetes Mellitus

Smoking

Family History

OCCUPATION

CONNECTIVE TISSUE DISORDERS

Past History:

Treatment History

Physical Examination

1. General Examination

2. Vital Signs

B.P Pulse

Respiration JVP Height cm Waveform

3. Systemic Examination

CVS

Inspection / Palpation

Apex Parasternal Heave

Palpable Sounds Thrills

Auscultation

S1 S2 Murmurs

Extra Heart Sounds

Other System

RS: PA: CNS:

ECG:

CHEST X-RAY PA VIEW

ECHOCARDIOGRAPHIC ASSESSMENT OF corpulmonale

Name: Age: Sex:

Echocardiographic parameters:

M-mode:

LV: EDD- ESD- EF- FS-

MAPSE

RV: RVFWT RVEDD TAPSE

Mitral valve:

Aortic valve: LVOT diameter:

LA:

Tricuspid valve:

Pulmonary valve:

RVOT: MPA:

2 D and DOPPLER HEMODYNAMIC ASSESSMENT:

Mitral inflow:

E-wave: Peak velocity- DT-

A-wave: Peak velocity- TVI-

E/A ratio:

TISSUE DOPPLER

Mitral annular: E' velocity- A' velocity-

E/E' ratio: MASV TASV

E PROPOGATION VELOCITY

IVRT:

IVCT:

Tricuspid inflow:

E-wave: Peak velocity- DT-

A-wave: Peak velocity- TVI-

PATIENT CONSENT FORM

STUDY TITLE:

"NEWER ECHOCARDIOGRAPHIC PARAMETERS IN ASSESSING RV AND LV FUNCTION IN PATIENTS WITH CORPULMONALE"

Patient may check (✓) these boxes.

PARTICIPANT NAME: DATE:

AGE: SEX: I.P.NO. :

The details of the study have been provided to me in writing and explained to me in my own language. ☐

I confirm that I have understood the purpose of the above study. I have the opportunity to ask the question and all my questions and doubts have been answered to my complete satisfaction.

I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐

I understand that investigator, the institution, regulatory authorities and the ethical committee will not need my permission to look at my health records both in respect to the current study and any further research that may be conducted in relation to it, even if I withdraw from the study. I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

I hereby consent to undergo complete physical examination, and diagnostic tests including hematological, biochemical, radiological and urine examinations ☐

I have been given an information sheet giving details of the study. ☐

I hereby consent to participate in the above study

Signature of the Participant

Information to Participants

Title: **NEWER ECHOCARDIOGRAPHIC PARAMETERS IN ASSESSING RV AND LV FUNCTION IN PATIENTS WITH CORPULMONALE**

Principal Investigator: Dr.N.VISWANATHAN

Co-Investigator (if any):

Name of Participant:

Site: RGGGH& MMC, Chennai

You are invited to take part in this research/ study/procedures/tests. The information in this document is meant to help you decide whether or not to take part. Please feel free to ask if you have any queries or concerns.

What is the purpose of research?

In patients with COPD not only RV dysfunction but LV diastolic and systolic dysfunction has been reported. Newer echocardiographic parameters like tissue Doppler are useful in picking early RV & LV dysfunction. The current study aims at using newer echocardiographic parameters in assessing RV&LV function in patients with corpulmonale. we have obtained permission from the institutional ethics committee.

The study design

It is a Retrospective cross-sectional study.

Study Procedures

The study involves evaluation of echocardiography **newer echocardiographic parameters like TAPSE, MAPSE, MASV and propagation velocity in assessing RV and LV function in patients with corpulmonale.** The results of the research may provide benefits to the society in terms of advancement of medical knowledge and/or therapeutic benefit to future patients.

Confidentiality of the information obtained from you

You have the right to confidentiality regarding the privacy of your medical information (personal details, results of physical examinations, investigations, and your medical history). By signing this document, you will be allowing the research team investigators, other study personnel, sponsors, Institutional Ethics Committee and any person or agency required by law like the Drug Controller General of India to view your data, if required.

The information from this study, if published in scientific journals or presented at scientific meetings, will not reveal your identity.

How will your decision to not participate in the study affect you?

Your decision not to participate in this research study will not affect your medical care or your relationship with the investigator or the institution. You will be taken care of and you will not lose any benefits to which you are entitled.

Can you decide to stop participating in the study once you start?

The participation in this research is purely voluntary and you have the right to withdraw from this study at any time during the course of the study without giving any reasons. However, it is advisable that you talk to the research team prior to stopping the treatment/discontinuing of procedures etc.

Signature of Investigator Signature of Participant

Date Date

ETHICAL COMMITTEE APPROVAL ORDER

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI -3

Telephone No : 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.N.Viswanathan,
PG in DM Cardiology.
MMC ,Chennai -3.

Dear Dr.N.VISWANATHAN

The Institutional Ethics committee of Madras Medical College, reviewed and discussed your application for approval of the proposal entitled "Newer Echocardiographic parameters in Assessing RV and LV function in patients with corpulmonale." No.05032013.

The following members of Ethics Committee were present in the meeting held on 05.03.2013 conducted at Madras Medical College, Chennai -3.

1. Dr.SivaKumar, MS FICS FAIS --- Chairperson
2. Prof. R. Nandhini MD -- Member Secretary
   Director, Instt. of Pharmacology ,MMC, Ch-3
3. Prof. Shyamraj MD -- Member
   Director i/c , Instt. of Biochemistry , MMC, Ch-3
4. Prof. P. Karkuzhali. MD -- Member
   Prof., Instt. of Pathology, MMC, Ch-3
5. Prof. A. Radhakrishnan MD -- Member
   Prof of Internal Medicine, MMC, Ch-3
6. Prof. S. Deivanayagam MS -- Member
   Prof of Surgery, MMC, Ch-3
7. Thiru. S. Govindsamy. BABL -- Lawyer
8. Tmt. Arnold Saulina MA MSW -- Social Scientist

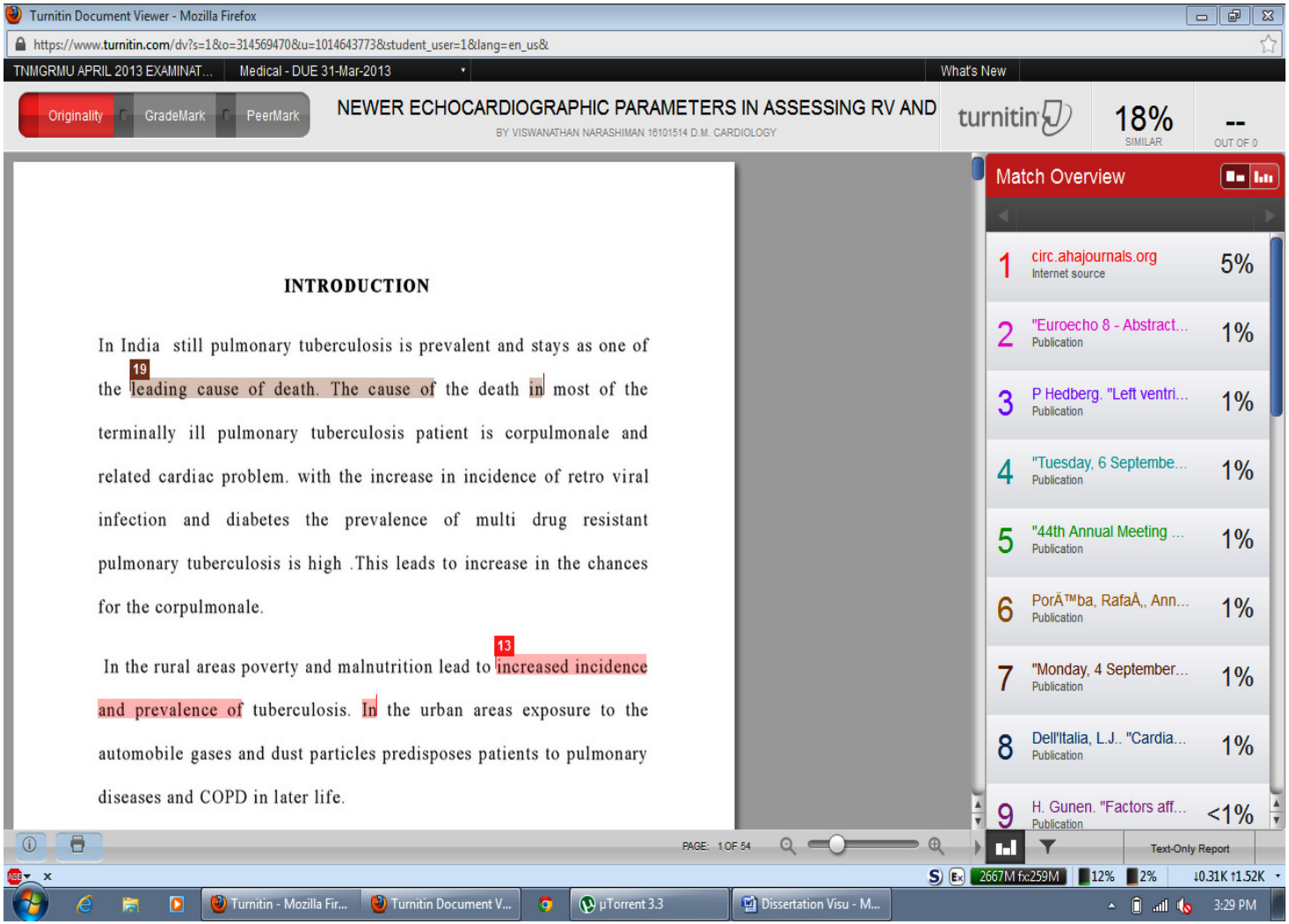
We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study, and SAE occurring in the course of the study, any changes in the protocol and patients information / informed consent and asks to be provided a copy of the final report.

R Nandhini

Member Secretary, Ethics Committee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In India still pulmonary tuberculosis is prevalent and stays as one of the leading cause of death. The cause of the death in most of the terminally ill pulmonary tuberculosis patient is corpulmonale and related cardiac problem. with the increase in incidence of retro viral infection and diabetes the prevalence of multi drug resistant pulmonary tuberculosis is high .This leads to increase in the chances for the corpulmonale.
In the rural areas poverty and malnutrition lead to increased incidence and prevalence of tuberculosis. In the urban areas exposure to the automobile gases and dust particles predisposes patients to pulmonary diseases and COPD in later life.
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E-mail	drmalathy19@yahoo.in
Submission time	24-Mar-2013 03:26PM
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INTRODUCTION In India still pulmonary tuberculosis is prevalent and stays as one of the leading cause of death. The cause of the death in most of the terminally ill pulmonary tuberculosis patient is corpulmonale and related cardiac problem. with the increase in incidence of retro viral infection and diabetes the prevalence of multi drug resistant pulmonary tuberculosis is high .This leads to increase in the chances for the corpulmonale. In the rural areas poverty and malnutrition lead to increased incidence and prevalence of tuberculosis. In the urban areas exposure to the automobile gases and dust particles predisposes patients to pulmonary diseases and COPD in later life. COPD in the later...

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In the rural areas poverty and malnutrition lead to increased incidence and prevalence of tuberculosis. In the urban areas exposure to the automobile gases and dust particles predisposes patients to pulmonary diseases and COPD in later life.

COPD in the later stages lead to right ventricular dilatation and corpulmonale. The development and implementation of the national programs for the detection and treatment of the tuberculosis is trying to treat the disease in the early stage itself to prevent such corpulmonale in future. In this study we are going to find easy solution to diagnose the lung disease related cardiac problem in the early stage itself without making mistakes.